WHAT IS CLAIMED IS:

1. A method for manufacturing GaN-based light-emitting diode (LED), comprising:

providing a substrate;

forming a GaN semiconductor epitaxy layer on said substrate, said GaN semiconductor epitaxy layer further comprising an n-type GaN contact layer, a light-emitting layer and a p-type GaN contact layer, said light-emitting layer being a light-emitting source;

forming a digital penetration layer on said p-type GaN contact layer, said digital penetration layer having functions of a p-type ohmic contact and high transmittancy with respect to light emitted by said light-emitting layer;

using a mutli-step dry etching method to etch said digital penetration layer, said p-type GaN contact layer, said light-emitting layer to form an n-metal forming area, etching terminating at said light-emitting layer;

forming a first ohmic contact electrode on said digital penetration layer for said p-type ohmic contact layer;

forming a second ohmic contact electrode on said n-metal forming area for said n-type ohmic contact layer;

forming pads on both said first ohmic contact electrode and said second ohmic contact electrode; and

forming a protective layer on said p/n junction area.

2. The method as claimed in Claim 1, wherein said digital penetration layer is formed with one the following methods: metal organic chemical vapor deposition (MOCVD), molecular beam epitaxy (MBE), and liquid phase epitaxy (LPE).

3. The method as claimed in Claim **1**, wherein said digital penetration layer is made of $Al_xIn_yGa_{1-x-y}N_zP_{1-z}$ and $Al_pIn_qGa_{1-p-q}N_rP_{1-r}$ with increasing (10Å-90Å) and decreasing (90Å-10Å) thickness, respectively, where $0<x,y,z,p,q,r<1$, and its conductivity can be either p-type, n-type, or I-type.

4. The method as claimed in Claim **1**, wherein said light-emitting layer emits light with wavelength between 380nm and 560nm, and the optical transmittancy of said digital penetration layer with respect to said wavelength is greater than 80%.

5. The method as claimed in Claim **1**, wherein said first ohmic contact electrode is made of Indium Tin Oxide (ITO).

6. The method as claimed in Claim **1**, wherein said first ohmic contact electrode has the thickness between 1000Å-4000Å.

7. The method as claimed in Claim **1**, wherein the distance between said first ohmic contact electrode and said substrate is greater than the distance between said second ohmic contact electrode and said substrate.

8. The method as claimed in Claim **1**, wherein said second ohmic contact electrode is made of one of the following materials or their combination: Ti, Al, Au, Ni, In, Sn, Zn, Cr, Cu, W, Pt, Pd, ITO, Indium Oxide, Tin Oxide, or Aluminum Zinc Oxide.

9. The method as claimed in Claim **1**, wherein said pads is made of one of the following materials or their combination: of Ti, Al, Au, Cr, Ni, and Pt.

10. The method as claimed in Claim **1**, wherein said n-metal forming area formed by a dry etching method has the depth of 1000Å-3000Å.

11. The method as claimed in Claim **1**, wherein said protective layer is an insulation layer.

12. The method as claimed in Claim 1, wherein said protective layer is made of one of the following: polyimide, parylene, and benzocyclobutene (BCB).

13. The method as claimed in Claim 1, wherein said multi-step dry etching method is a single-step dry etching method, said single-step dry etching method further comprising:

etching, in the order of, said digital penetration layer, said p-type GaN contact layer, and said light-emitting layer;

terminating etching at said light-emitting layer; and

forming an n-metal forming layer in said light-emitting layer.

14. The method as claimed in Claim 1, wherein said multi-step dry etching method is a two-step dry etching method, said two-step dry etching method further comprising:

etching, in the order of, said digital penetration layer, said p-type GaN contact layer, and said light-emitting layer;

terminating etching at said light-emitting layer;

forming an n-metal forming layer in said light-emitting layer;

etching, in the order of, said light-emitting layer, said n-type GaN contact layer to form a trench in said n-metal forming area; and

terminating etching at said n-type GaN contact layer, said trench being used for separating p/n junction.

15. The method as claimed in Claim 14, wherein said trench created by said multi-step dry etching method has the width of 0.2mm.